PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 4 : B63B 7/08, 1/10

A1

(11) International Publication Number: WO 86/ 07025

(43) International Publication Date: 4 December 1986 (04.12.86)

(21) International Application Number: PCT/US86/01144

(22) International Filing Date: 27 May 1986 (27.05.86)

(31) Priority Application Number: 738,212

(32) Priority Date: 28 May 1985 (28.05.85)

(33) Priority Country: US

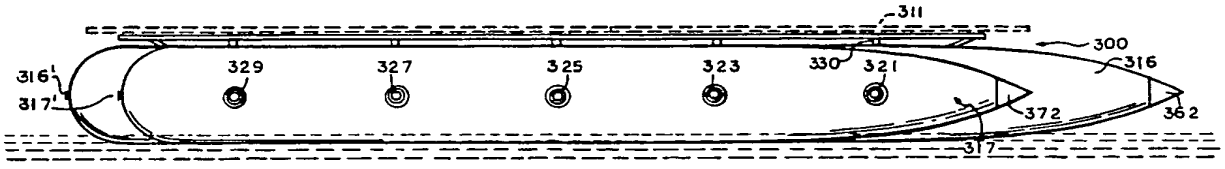
(71)(72) Applicant and Inventor: PALMER, John, M., Jr. [US/US]; P.O. Box 2171, Lutz, FL 33549 (US).

(74) Agent: McCLURE, Charles, A.; P.O. Box 1168, Tampa, FL 33601 (US).

(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BG, BR, CH, CH (European patent), DE (Utility model), DE (European patent), DK, FI, FR (European patent), GB, GB (European patent), HU, IT (European patent), JP (Utility model), KR, LK, LU (European patent), MC, MG, NL, NL (European patent), NO, RO, SE, SE (European patent), SU.

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: INFLATABLE AQUATIC VESSELS



(57) Abstract

Aquatic vessels having inflatable hull envelopes (316-317) that receive transversely (i.e., are transected by) tie members (321-329) for carrying framework upon which decking, propulsion means, etc. are supported. The hull envelopes, which are generally cigar-shaped, are located side by side, with or without spacing of adjacent envelopes apart. Engine-propulsion and/or wind-propulsion means can be supported on the framework, with or without adaptation of the hull envelopes thereto. Such vessels are useful for general transportation, or special recreational uses such as carrying persons for coastal or deep-sea fishing, or for pulling persons on water skies along the surface, or persons held aloft by a parachute-like sail (or 'parasail') above the surface, and they are capable of high-speed travel.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**GA**	Gabon	**MR**	Mauritania
AU	Australia	**GB**	United Kingdom	**MW**	Malawi
BB	Barbados	**HU**	Hungary	**NL**	Netherlands
BE	Belgium	**IT**	Italy	**NO**	Norway
BG	Bulgaria	**JP**	Japan	**RO**	Romania
BR	Brazil	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SN**	Senegal
CH	Switzerland	**LI**	Liechtenstein	**SU**	Soviet Union
CM	Cameroon	**LK**	Sri Lanka	**TD**	Chad
DE	Germany, Federal Republic of	**LU**	Luxembourg	**TG**	Togo
DK	Denmark	**MC**	Monaco	**US**	United States of America
FI	Finland	**MG**	Madagascar		
FR	France	**ML**	Mali		

INFLATABLE AQUATIC VESSELS

TECHNICAL FIELD

This invention relates to assembly, structure, and use of aquatic vessels having hull members including inflatable envelopes.

BACKGROUND ART

Inflatables have been known as means of aquatic amusement, transport, and otherwise for years. Frequently they have been attached to one another or to other items by lashing them together, which is awkward and often risky. Instead or in addition, inflatables may be adhered or bonded together, directly or through intermediate devices to which they have been attached similarly. However, when such a connection has been successful the resulting structure may be so badly stressed as to be unsafe, or so difficult to assemble and disassemble as to be impractical.

The flexibility of inflatable hull members complicates their lateral connection. Popkin U.S. Patent 4,136,414 discloses transverse connecting members (also keel-like reinforcing members) retained frictionally in flexible sleeves formed at the exterior of the hull envelopes and retained in place by hull compression against the sleeves. More complex connectors are also known.

Rigid hull members may be aligned side-by-side by means of transverse spars extending from one hull to fastening means on (or even into an opening in) another such hull. However, the strengths of rigid materials used, and the distribution of stresses in rigid bodies, are so different from the conditions in inflatables that what is applicable to rigid hulls is normally not suitable in inflatables. Therefore, persons skilled in making rigid hull vessels are unlikely to undertake to make vessels with inflatable hulls or, if they should do so, are unlikely to try to use with inflatables their methods for working with rigid hulls.

Similarly, aquatic vessels with inflatable hull members are subject to such constraints that persons skilled in making or using them know enough to avoid conventional rigid hull techniques in so doing--and they also know enough not to attempt high-speed propulsion thereof.

My invention is directed to bringing boats or other aquatic vessels with inflatable hull members to structural and operational levels not hitherto attempted or attained.

DISCLOSURE OF THE INVENTION

In general, the objects of this invention are attained, in an aquatic vessel, having at least one inflatable hull member, by tie means transecting the hull, and framework including means interconnecting to and supported by the tie means. Preferably a plurality of inflatable hull members are so interconnected, and thereby distribute the burden of supporting the framework, which supports decking, propulsion means, superstructure, etc.

A primary object of the present invention is provision of inflatables with means for assembling or connecting them to turn their characteristics of inflatability and flexibility from an actual or potential disadvantage into a benefit.

Another object of this invention is assembly of portable inflatable envelopes, as modules, into larger structures that are either portable only with difficulty, or not at all, when assembled--but that can be readily disassembled.

A further object of the invention is equipping of aquatic vessels having inflatable hull members for high-speed travel.

Yet another object is provision of structural means for facilitating the foregoing objects in a safe manner.

A still further object is provision of aquatic vessels with novel structural and operational characteristics.

Other objects of the invention, together with means and methods for attaining the various objects, will be apparent from the following description and the accompanying diagrams of various embodiments of a multi-hulled type of vessel, being presented by way of example rather than limitation.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 a top plan view of a first embodiment of hull assembly for an inflatable aquatic vessel according to the present invention;

Fig. 2 is a similar plan view of a second embodiment of hull assembly of such a vessel according to this invention;

Fig. 3 is a plan of a third hull assembly embodiment according to the invention; and

Fig. 4 is a side elevation of the same hull assembly embodiment of the last view, corresponding in outline to any of the embodiments.

Fig. 5 is a rear elevation of the hull assembly of Fig. 1;

Fig. 6 is a rear elevation of the hull assembly of Fig. 2;

Fig. 7 is a rear elevation of the hull assembly of Fig. 3;

Fig. 8 is a rear elevation of the third embodiment similar to Fig. 7 but with the addition of propulsion means in the form of an outboard engine; and

Fig. 9 is a rear elevation of the first embodiment similar to Fig. 5 but with the addition of propulsion means in the form of an inboard engine.

Fig. 10 is a rear elevation of the hull assembly of Figs. 1 and 5, on an enlarged scale;

Fig. 11 is a similarly enlarged rear elevation of the hull assembly of Figs. 3 and 7;

Fig. 12 is a transverse sectional elevation through a hull envelope along one of the transecting tie members;

Fig. 13 is a sectional elevation taken at XIII-XIII on Fig. 12;

Fig. 14 is a further enlarged elevation of hub detail, from the right side of Fig. 12, viewed in the same direction;

Fig. 15 is a side elevation of the same hub detail viewed in a horizontal direction perpendicular to Fig. 13; and

Fig. 15A is a view, similar to Fig. 14, of an alternative hub;

Fig. 16 is a side elevation of a hull assembly sectioned between hull envelopes;

Fig. 17 is a side elevation of a hull assembly similar to Fig. 16 but with addition of a mast step, keel, and rudder;

Fig. 18 is a side elevation of a hull assembly similar to Fig. 16 but with the addition of an outboard engine; and

Fig. 19 is a side elevation of a hull assembly similar to Fig. 16 but with the addition of an inboard engine.

Fig. 20 is a side elevation of an engine well, adapted to fit into an appropriately concave modified hull envelope;

Fig. 21 is an exploded side elevation of a liner and the aft portion of a truncated hull envelope modified to receive such liner;

Fig. 22 is a sectional side elevation, on an enlarged scale, at the conjunction of the members of the last few views;

Fig. 23 is a transverse sectional elevation of a liner for an engine well, such as shown in the preceding views, and

Fig. 24 is a detail, on a further enlarged scale, of retaining means installed at the upper right corner of Fig. 23.

Fig. 25 is a side elevation of the prow of an aquatic vessel of this invention, with a cockpit therein shown in broken lines;

Fig. 26 is a fragmentary side elevation of an inflatable hull envelope of the invention, with added nose cone; and

Fig. 27 is a partially exploded side elevation of such a nose cone assembly.

MODES FOR CARRYING OUT THE INVENTION

Fig. 1 shows, as a first embodiment, hull assembly 100 of an aquatic vessel according to this invention in plan (top) comprising a trio of elongated or cigar-like inflatables, as inflated float or hull envelopes in adjacent parallel arrangement. Each envelope is relatively impervious to both gaseous and liquid fluids and encloses enough air to fill it snugly.

The aft or rear end of each envelope, at the left in Fig. 1, is shown rounded, whereas the forward or front end of it, at the right, appears pointed (by reason of an added nose cone, detailed later). Long central envelope 115 is flanked by pair of somewhat shorter aligned contiguous envelopes 114 and 116 of like diameter. Filler valves 114', 115', and 116' appear at the aft end, and nose cones 142, 152, and 162 at the forward end, of the hull envelopes.

Extending transversely through (i.e., transecting) hull assembly 100, as indicated here in dashed lines, are aligned sleeves in all the respective float or hull envelopes. Five sets of sleeves appear, with the third set being located approximately amidships, the first and second sets located forward, and the fourth and fifth sets aft. Thus, at the right, forwardmost sleeve 151 of envelope 115 lines up with corresponding sleeve 141 of envelope 114 toward the top of the diagram, at the left or port side of the hull assembly, and with like sleeve 161 of envelope 116 located on the opposite or starboard side, toward the bottom of the view. Likewise, sleeves 153, 155, 157, and 159 of envelope 115 are aligned, respectively, with sleeves 143, 145, 147, and 149, and with sleeves 163, 165, 167, and 169. Each sleeve is as impervious as its surrounding envelope and is bonded at its ends to the sidewalls of its envelope, so it seals the interior of the envelope from the exterior.

Visible at the opposite sides of the hull assembly are the ends of tie members 121, 123, 125, 127, and 129--which may be all alike or nearly so. Their ends are protruding from the corresponding aligned sleeves, in the inflatable hull members, into which tie members are inserted during assembly and from which they may be removed for disassembly. These tie members are shown in detail in subsequent drawings and are described further after description of alternative hull embodiments.

During assembly, tie members are inserted into framework (see below), and the hull envelope sleeves are slid onto the tie members then or afterward--depending in part on whether the envelopes are within or outside the framework--and the envelopes are inflated (if not already full) and also are secured to the tie members. Disassembly is accomplished by merely reversing the order of the assembly procedure. The hull envelopes may be transported disinflated or partially or wholly inflated.

Also indicated in Fig. 1, is decking 111, superimposed (in dashed lines) on the hull assembly. The decking is pentagonal in plan, with parallel sides overlapping somewhat more than half of the outermost hull envelopes, tapering to a pointed forward end overlying the transverse bisector (not indicated) of the foremost sleeve, and somewhat convex at the aft end.

Fig. 2 shows, in plan, hull assembly 200 according to this invention. This second embodiment differs from the first embodiment mainly by having the hull envelopes spaced apart laterally in trimaran fashion. Here and in later diagrams of this embodiment, the reference numbers that designate parts or features corresponding to those in the preceding view are larger by one hundred (i.e., with the same two digits preceded by 2, instead of by 1) and, thus, are not necessarily mentioned separately. Thus, central hull envelope 215 is flanked by hull envelopes 214 and 216 and is spaced therefrom by respective longitudinal gaps 204 and 206. The length-to-width ratio is reduced accordingly, and superimposed (dashed line) decking 211 is similarly wider and has a less acutely angled forward end.

Fig. 3 shows, also in plan, a third embodiment of hull assembly 300 of the invention. Here and in subsequent views of this embodiment reference numerals for corresponding parts or features are increased by another hundred (i.e., the same two digits preceded by 3, instead of by 1 or 2).

This third embodiment differs from the previous embodiments by having two hull envelope pairs spaced apart on opposite sides of longitudinal gap 305. Hull envelopes 313 and 314 constitute the port pair, while envelopes 316 and 317 constitute the starboard pair.

Fig. 4 shows, in side elevation, the same hull assembly as in Fig. 3. Actually, each of the embodiments might appear identical viewed in such direction, but here the reference numerals of Fig. 3 are used. Dashed lines are superimposed below and on the lower part of the assembly to signify water, which the vessel floats in or upon and is adapted to traverse. Decking 311 is seen to be carried on supports 330, just barely visible protruding above the hull envelopes. Details of the framework, including supports, appear in the next views.

Fig. 5 shows, in rear elevation, hull assembly 100 of Fig. 1, with decking 111 shown in solid. Also shown are generally Y-shaped framework members 184 and 186, upon which the decking is supported via one or more transverse topping members. Later views show how the framework is supported via the tie members, of which only the ends of one member (129) appear here.

Fig. 6 shows, in rear elevation, hull assembly 200 of Fig. 2, with decking 211 shown in solid. Also shown are framework members 284 and 286, in generally rectangular cross-braced form, supporting the decking. Tie member 229 is visible passing through the frame members in the gaps between adjacent hull envelopes; details of the hull interconnection appear in later views.

Fig. 7 shows, in rear elevation, hull assembly 300 of Fig. 3, with decking 311 shown in solid. Central framework member 385, in generally rectangular cross-braced form, is shown between flanking pairs of hull envelopes (313, 314 and 316, 317), whereas generally triangular framework members 383 and 387 are within the respective hull pairs. This framework appears in further detail later.

Fig. 8 shows, in rear elevation, the last shown hull assembly with addition of outboard motor assembly supported by central frame member 385 and including motor housing 391, drive shaft housing 392, and screw propellor 393.

Fig. 9 shows, in rear elevation, first hull assembly 100, with modified central hull envelope 115' backed up with engine well 190 (shown further in subsequent views), within which the engine assembly itself is concealed; drive shaft housing 192 and screw propellor 193 are visible aft of the engine well.

Fig. 10 shows, in front elevation, first hull assembly 100 on an enlarged scale. Visible members of framework 180 include two Y members (184 and 186) much as shown in Figs. 5 and 9, here topped by single transverse member 181 of the framework. Tie member 121, whose ends are barely visible, is also slightly visible between the hull envelopes, where it passes through vertical hub 85 of each such Y member. Decking 111 is spaced slightly above transverse frame member 181 by intervening central and side longitudinal box strips 113.

Fig. 11 is a similarly enlarged front elevation of second hull assembly 200, whose framework 380 comprises spaced pair of vertical members rising from hubs 85 and being connected by X bracing and topped by transverse frame member 381. Tie member 321 is seen traversing the space (305) between hull envelopes 314 and 316 as well as the vertical hubs. The two outermost envelopes (313 and 317) are omitted from this view, and the tie member is cut away at each end accordingly, by reason of space limitations.

Fig. 12 is a transverse sectional elevation, showing in detail typical relationship of a hull envelope, transecting tie member, and framework--as at the leftmost portion of Fig. 10 or other comparable location in a hull assembly of this invention, whichever particular embodiment it may be.

Hull envelope 16 (designated by only two digits to indicate its use in any assembly embodiment) has diametral horizontal sleeve 45 therethrough open at its ends and transected by tie member 21, so designated--without prefixed hundreds digit--to indicate general utility as tie member 121, 221, 321 (or other tie member) of the illustrated embodiments or in an equivalent structure not so exemplified. Interior flanges 43 and exterior flanges 47 reinforce the junction of the envelope and the sleeve to preclude leakage of air out of (or water into) the envelope. Plug cap 20 terminates the leftmost end of the tie member. This sectional view may be taken as exemplifying most of the left part of Fig. 10.

Fig. 13 shows, on an enlarged scale, a section taken perpendicularly through sleeve 45 and tie member 21 viewed along their common axis from inside hull envelope 16, as indicated at XIII-XIII on Fig. 12. Wall thicknesses here are exaggerated in the interest of clarity; the components appear as concentric circles, some being shaded. Interior flange 43 is visible as the unshaded annular space between the two outermost circles; the adjacent narrower unshaded annulus represents the inwardly facing edge of flange hub 43A. Bolts or screws 45B through the flange appear head-on. Sleeve 45 is the next annular ring (shaded for metallic composition), and tie member 21 is a thicker, similarly shaded ring therewithin. Blank circular space 45' about the center indicates that this tie member has a tubular rather than an alternative solid construction. Exterior flange 47 (not visible here) and the visible interior flange grip an intervening portion of hull envelope 16 (hidden) tightly between them and thereby seal the interior of the hull envelope from the exterior.

Fig. 14 shows, in sectional elevation the rightmost or hub portion of Fig. 12. At its top portion, hub 85 adjoins longitudinally extending box member 88 at the bottom of a vertically extending (unnumbered) framework member, whose upper portion is simply not shown--but which could be part of triangular framework as in the first and third hull assembly embodiments, or rectangular framework as in the second and third embodiments--or similar structure.

Fig. 15 shows hub 85 of preceding views in end elevation, with tie member 29 sectioned accordingly and passing through a close-fitting bore (unnumbered) in the hub. The hub is also bored perpendicularly to and intersecting such mating or close-fitting bore and is threaded to receive pair of bolts 89 therein from opposite sides to pinch the outside of the tie member between them and to assist in affixing the framework to the tie member.

Fig. 15A shows in like manner modified hub 85', whose bore 87 for receiving a tie member (21) is elongated in the fore-and-aft direction to accommodate minor misalignment of the members. Again, the tie member is pinched between pair of bolts 89, here shown in solid lines within bore 87 as well as in broken lines within the threaded bore.

Fig. 16 shows the hull assembly of an aquatic vessel of the present invention in longitudinal section alongside a hull member and through the framework hub locations. As this illustration is representative of a like view through any exemplified embodiment, counterparts here (and in later diagrams) of parts that would be uniquely referenced in any such embodiment (including a hundrds digit) have shortened two-digit reference numerals, whereas elements without such counterparts have one-digit reference numerals, to indicate their general utility. Truss-braced framework 80 receives tie members 27 and 29 through aft hubs 85, and receives forwardmost tie member through hub 85'.

Most of the intervening assembly is cut away to conserve space in Fig. 16 and in subsequent views. The tie members transect hull envelope 14 (as well as at least one adjacent envelope, not visible here) and so support framework 80, also decking 11 via intervening transverse members 13. Fig. 17 is similar to Fig. 16 but cut away at a further forward location and plus optional elements especially suited to wind-propulsion of the vessel. Thus, mast step 2, with base of mast 3 therein, is shown mounted on the top part of the framework overlying keel 5, which is supported on the underside of the framework in the vicinity of the third hub (85') and the fourth hub (85), counting from the bow. Tiller 6 is at the top of rudder shaft 7, which is journaled in fitting 8 affixed to the framework, in the vicinity of aft hub 85, and is thereby adapted to adjust the orientation of rudder 9. Such a vessel is especially suited to wind propulsion, wholly or partly.

Fig. 18 differs from Fig. 16 only in being equipped for power propulsion, specifically by means of outboard motor assembly 91 supported on bracket 95 secured to the framework in the vicinity of aft hubs 85 and having screw propellor 93 driven through means in intervening housing 92.

Fig. 19 shows modified hull assembly 10' whose hull envelope 15' is truncated and concave at the rear to receive engine well 90, which also is transected by tie members 27, 29 through aft hubs 85. Screw propellor 93 is driven from an engine concealed in the well via driveshaft means hidden by intervening housing 92'--somewhat different from the corresponding outboard feature in the preceding view.

Fig. 20 shows engine well 90 in side elevation, apart from the hull assembly. It resembles a conventional form of baby basket or carriage, with a generally rectangular body portion and convex head portion 98. It also has a pair of transverse openings 97 to receive two tie members.

Fig. 21 shows, in exploded side elevation, hemispherical hull-reinforcing compression member 99 at the left, and at the right the aft end of truncated hull envelope 15', which has concavity 15C into which the compression member fits. The compression member also fits, of course, over convex end 98 of the engine well (illustrated in the preceding view), as shown further in the next view.

Fig. 22 shows, in partial longitudinal section, modified hull envelope 15' and engine well 90, which are separated by compression member 99. Concave end piece 15C fits within the aft end of the envelope and is sealed also thereto by adhesive along strip 15A all around. The end piece is recessed within the open end of the hull envelope to leave part of the envelope protruding. Here resulting flap 15B is shown bent around and back over the rim of the reinforcing compression member and is similarly sealed to it. The compression member thereby safeguards the hull end cap from being expelled by the hull inflation pressure, and it also incidentally protects the hull envelope from possible damage from activities in the engine well.

The various sectioned members at the left in Fig. 22 are shaded for thermosetting or thermoplastic compositions. At the right tie member 25 (shaded for metal) is seen inside an interior flange (43) of the hull envelope sleeve (hidden).

Fig. 23 shows, in transverse elevation, a forward portion of further modified hull envelope 15" having concave part 15K in its upper surface cockpit structure 90' otherwise analogous to engine well 90. Generally semicylindrical compression member 15L fits flush in the concavity.

Fig. 24 is a similar sectional detail of one edge of the modified structure shown in Fig. 23. One of a series of bolts or rivets 15M illustrates satisfactory securing means. Either (or both) adhesive or (and) mechanical joining means may be used here or in the structure of the preceding view for more security against such undesirable occurrences as leaks or other physical separation.

Fig. 25 is a fragmentary side elevation of the forward end of further modified hull envelope 15" in the vicinity of the portion shown in the last two preceding views. Cockpit concavity 15K is indicated in part by a dashed line and in part by visible recessing of the envelope sidewalls at 15R. The tapered nose portion may or may not be partially recessed for such purpose aft of nose cone 14C, so its inner structure is not shown here but is analogous to and is understandable the presentation of nose cone construction according to this invention in the final diagram.

Fig. 26 shows the pointed forward end of representative hull envelope 14 having distinguishable nose cone 14C. The forwardmost exterior flange 47 and transecting tie member 21 are at the left, as they were in the preceding diagram. Fig. 27 shows in partially exploded axial section the hull structure at the junction of hull envelope 14 and nose cone 14C (shown partly cut away). The frustoconical forward end of the envelope is folded as flap 14F back inward around acute-angled rim 14A of cylindrical insert 14B at the left. Midway in Fig. 27, frustoconical plug 14D (somewhat like a barrel truncated at both ends) fits at its left end 14L within the rim of the cylindrical insert, and at its right end 14R within the open base end of the nose cone. The illustration of a pointed nose cone is not intended to preclude use of alternatively shaped nose cones on hull envelopes or omission of nose cones altogether, as rounded ends may indeed be preferred in some uses of such aquatic vessels. Conversely, the aft ends of hull envelopes (shown rounded in the diagrams) may be equipped with tail cones similar to or different from nose cones.

It will be understood that vessels having hull assemblies according to this invention may have additional features as well, supported by the framework, such as superstructure with or without accommodations for crew and passengers, or usual recreational equipment such as winch and cable used in pulling water-skiers or parasailers, and may be outfitted for whatever means of propulsion may be desired, including not only those already shown but also engine-driven air propellors, air or water jet-propulsion means, or others. Suitable propulsion means will drive such a vessel at gale speed or faster, such as about 100 kilometers per hour. The inflatable structure, although it may seem more fragile than rigid hulls, is better able to withstand waves, sudden shocks, and vibration--apparently because the inflated hull envelopes absorb and damp out movements that would break apart or crush wholly rigid structures. The dynamics of inflatable aquatic vessels constructed according to this invention cannot be appreciated without having being aboard such a vessel. Its relatively shallow draft enables it to pass over submerged objects that might snag rigid-hull structures, and its flexibility or resilience reduces the likelihood of being damaged in collisions with submerged or floating objects.

It will be understood that the flexible hull envelopes may be composed of a wide range of elastomeric and polymeric materials, with or without added reinforcement, e.g., fibers, filaments, or fabrics of like or unlike composition. Glass textiles are common reinforcing materials. Suitable hull envelope compositions include polyvinyl chloride, synthetic rubbers such as butadiene, hydrocarbons such as polyethylene and polypropylene, and film-forming polyamides or nylons, also aromatic polyamides or aramides, and polyesters such as polyethylene terephthalate, for example. Polyurethane is an example of an often preferred hull envelope composition.

As no particular composition is essential to construction of the envelopes, the designer or builder of inflatables has indeed a satisfactory range of materials to select from, and may choose according to cost, environment, stress, utility, and other pertinent factors.

The sleeves and their flanges and the tie members may, but need not, be made of the same or similar materials as the flexible envelopes, and may vary considerably therefrom in their physical characteristics, whether made of similar or different materials. The sleeves and flanges may be of like composition, especially if desired to be flexible, and for more nearly rigid construction polyvinyl chloride is a good choice of polymeric material. Other suitable materials include metals, such as aluminum or stainless steel, and even wood may be used if desired. Whereas the envelope material may be on the order of a millimeter or two thick, flanges and tubular tie members usually have greater wall thickness (such as a few millimeters to as much as several centimeters) and usually are ten or more centimeters in diameter--as also are rodlike tie members. Flanges may be bonded to the sleeves adhesively or by fusion, welding or other suitable method depending upon composition.

Composition selection and the dimensional and the other physical specifications for the envelopes, the flanges, the sleeves, and the tie members, depend principally upon the usage contemplated, such as the size of a resulting assembly and external stresses to which it is likely to be exposed. A small assembly of lightweight envelopes for use under sail for coastal fishing may well accommodate smaller or weaker components than are desirable in a larger assembly designed for ocean use under motor propulsion. Experienced sailors will have less difficulty than landlubbers in judging the appropriateness of various component materials, and all users of such assemblies will learn from actual experience.

Air is the most common inflatant, but carbon dioxide, nitrogen, or other gases may be used, such as especially where non-combustibility is important. Relatively low inflation pressure, such as one-tenth kilogram per square centimeter (about one and one-half pounds per square inch) is adequate to induce a satisfactorily high skin tension in the hull envelopes. Water or the like may be substituted in part, for whatever reason, as when an intermediate or high density is desired, perhaps for operations on land or under water. Each envelope may contain one or a plurality of compartments.

It should be apparent from the previous description that the assemblies of this invention are easy to set up and to take down, as well as to ship disassembled. Especially when deflated, the individual envelopes, along with their built-in sleeves, and the tie members can be carried piece-by-piece readily enough by one or several people.

It may be desirable for the sleeves to be made flexible enough that fully inflated envelopes constrict the sleeves sufficiently to grip irremovably the tie members inside. In that event it may be less important to provide retaining means on or for tie members, although caps bonded or screwed on or plugs inserted therein may be desirable to seal them or to provide a slot or tiepoint for rope, etc.

Alternatively, it may be preferable to use relatively rigid sleeve material, so that the tie members (similarly rigid) can be readily inserted and also be withdrawn at or near full inflation. Instead of bolts or screws already shown and described (or equivalent hub-retaining means), fastener or knobs on the ends of the tie members, or covers over the open sleeve ends, may be used.

The number of inflatable hull envelopes may be increased. Thus, a pair of inflatable hull envelopes may be added, to flank the three envelopes of either the first embodiment or the second embodiment, and may be either mutually adjacent thereto or spaced therefrom in either instance. An added pair of inflatable hull envelopes may flank the spaced pairs of such envelopes in the third embodiment, whether adjacent thereto or spaced therefrom. Also, similar inflatable hull envelopes may be added ahead of or behind hull envelopes (or spaces therebetween) or both fore and aft thereof.

INDUSTRIAL APPLICABILITY

Recreational uses of these inflatable aquatic vessels, such as fishing or pulling water-skiers or persons carried by parasails, have been mentioned. Accordingly, they are very valuable in transporting tourists and members of the general public for those and other purposes. Moreover, the decreased draft and the "slippery" construction thereof reduce drag and render them quite economical to operate, especially at high speeds at which conventional vessels become very uneconomical. These inflatable vessels are efficient in transportation of both people and goods, and--as they are increasingly accepted for doing so--their design, manufacture, sale, and delivery will grow and will give rise to a whole new industry and will create many jobs.

Modifications or variants of the exemplified embodiments and their components have been suggested above, such as in number, size, shape, and the positioning of components. Other changes may be made, such as by adding, deleting, combining, or subdividing parts or steps, while retaining at least some of the advantages and benefits of this invention, which itself is defined in the following claims.

THE CLAIMED INVENTION:

1. Aquatic vessel having at least one inflatable hull envelope, characterized by tie means transecting the same, and framework interconnected to and supported by the tie means.

2. Aquatic vessel according to claim 1, characterized further by a plurality of such inflatable hull envelopes, with such tie means therethrough supporting such framework.

3. Aquatic vessel according to claim 2, characterized further in that the tie means includes a plurality of tie members transecting a plurality of such inflatable hull envelopes.

4. Aquatic vessel according to claim 3, characterized further in that the framework includes hub members having a mating fit about a pair of such tie members located fore and aft, respectively, of one another.

5. Aquatic vessel according to claim 4, characterized further in that such a hub member also includes means for retaining a tie member therethrough from moving lengthwise therein when completely assembled.

6. Aquatic vessel according to claim 4, characterized further in that the framework includes hub members having a non-mating fit, about other of the tie members than the tie members fitted to the respective mating hubs, each of such hub members with such non-mating fit being provided with fore-and-aft fit-adjustment and retaining means.

7. Aquatic vessel according to claim 3, characterized further in that each of such inflatable hull members is transected by a plurality of such tie members, and framework supported by the tie members via interconnection thereto also supports propulsion means.

8. Aquatic vessel according to claim 7, characterized further in that the propulsion means includes a mast supported by such framework.

9. Aquatic vessel according to claim 7, characterized further in that the propulsion means includes an outboard engine supported by such framework.

10. Aquatic vessel according to claim 7, characterized further in that the propulsion means includes an inboard engine supported by such framework.

11. Aquatic vessel according to claim 1, characterized further in that a plurality of such inflatable hull envelopes are flanking a laterally centralmost inflatable hull envelope, and each of such inflatable hull envelopes is transected by at least two tie members.

12. Aquatic vessel according to claim 11, characterized further in that the flanking inflatable hull envelopes are laterally contiguous with the central hull envelope.

13. Aquatic vessel according to claim 11, characterized further in that the flanking inflatable hull envelopes are spaced apart from the central inflatable hull envelope.

14. Aquatic vessel according to claim 11, characterized further in that the framework supports propulsion means.

15. Aquatic vessel according to claim 14, characterized in that the propulsion means includes an engine, aligned with the centralmost inflatable hull envelope.

16. Aquatic vessel according to claim 11, characterized in that the centralmost inflatable hull envelope includes a cockpit, recessed therein.

17. Aquatic vessel according to claim 3, characterized further in that a plurality of inflatable hull envelopes are spaced laterally apart from one another at opposite sides of a longitudinal bisector of the vessel, and each of such hull envelopes is transected by at least two tie members.

18. Aquatic vessel according to claim 17, characterized further in that the framework supports propulsion means between the spaced inflatable hull envelopes and laterally aligned with the longitudinal bisector.

19. Aquatic vessel according to claim 18, characterized further in that the propulsion means includes an engine.

20. Aquatic vessel according to claim 17, characterized further by having at least two inflatable hull envelopes at each of the opposite sides of the longitudinal bisector.

21. Method of assembling an aquatic vessel having a plurality of hull members comprising inflatable envelopes, each hull member having a plurality of open-ended sleeve members transecting each such envelope, with each such sleeve member sealed to the walls of its envelope, thereby sealing off the envelope from the exterior, and having rigid framework adapted to receive and attach to tie members,

the method being characterized by the steps of

inserting tie members through such framework and through such sleeve members, each of such tie members transecting sleeve members in a plurality of such envelopes, and

attaching framework to such tie members between adjacent hull members.

22. Aquatic vessel assembly method according to claim 21, characterized further by inflating such envelopes before inserting tie members through the sleeves of the envelopes.

23. Aquatic vessel assembly method according to claim 21, characterized further by inflating such envelopes after inserting tie members through the sleeves of the envelopes.

24. Aquatic vessel assembly method according to claim 22, wherein the sleeves are flexible, characterized further by inflating the hull members with the tie members in place in the sleeves, whereby the tie members are gripped laterally by the sleeves as the envelopes expand upon being inflated, thereby aiding in securing the hull members together.

25. Aquatic vessel assembly method according to claim 20, wherein such framework includes laterally spaced hubs aligned with such sleeves, characterized further by inserting the tie members through the hubs as well as the sleeves.

26. Aquatic vessel assembly method according to claim 24, wherein the sleeves are inflexible, and the framework hubs include adjustable attaching means, characterized further by adjusting the attaching means to hold the tie members in place therein and thereby aid in securing the hull members together.

27. Aquatic vessel assembly method according to claim 21, characterized further by the steps of

inserting a central inflatable hull member within framework means having laterally spaced and aligned hub members, and

flanking the central inflatable hull member with a pair of additional inflatable hull members, each such inflatable hull member having a plurality of like aligned transecting sleeves, and

inserting tie members through the respective aligned sleeves and hubs.

28. Aquatic vessel assembly method according to claim 27, characterized further by the steps of

flanking the central inflatable hull member with a plurality of additional inflatable hull members, and

inserting tie members also therethrough.

29. Aquatic vessel assembly method according to claim 21, characterized further by the steps of

spacing a plurality of inflatable hull members apart on opposite sides of a longitudinal bisector of framework means having laterally spaced and aligned hub members,

each such inflatable hull member having a plurality of like aligned transecting sleeves, and

inserting tie members through the respective aligned sleeves and hubs.

30. Aquatic vessel assembly method according to claim 29, characterized further by the steps of

flanking the plurality of spaced inflatable hull members by a plurality of additional inflatable hull members,

whereby there are at least two such inflatable hull members on opposite sides of the longitudinal bisector,

and inserting tie members also therethrough.

31. Aquatic vessel assembled according to claim 21.

32. Aquatic vessel assembled according to claim 28

33. Aquatic vessel assembled according to claim 30.

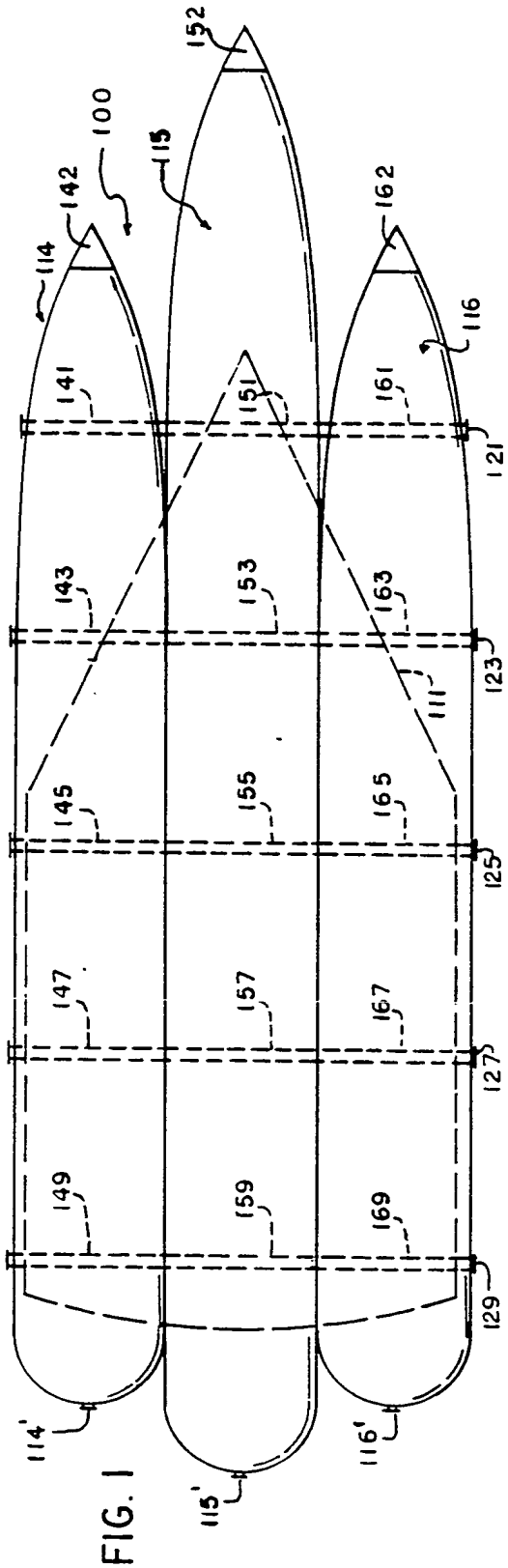


FIG. 1

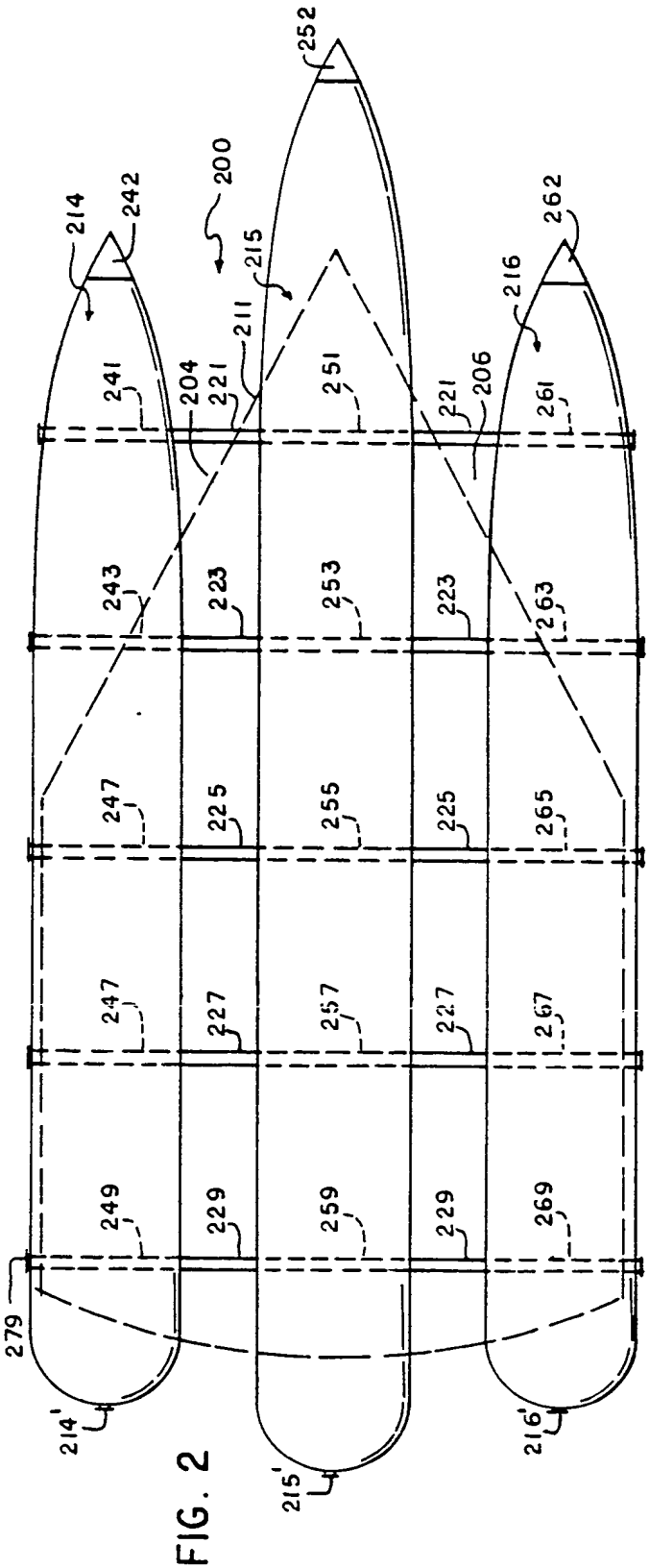


FIG. 2

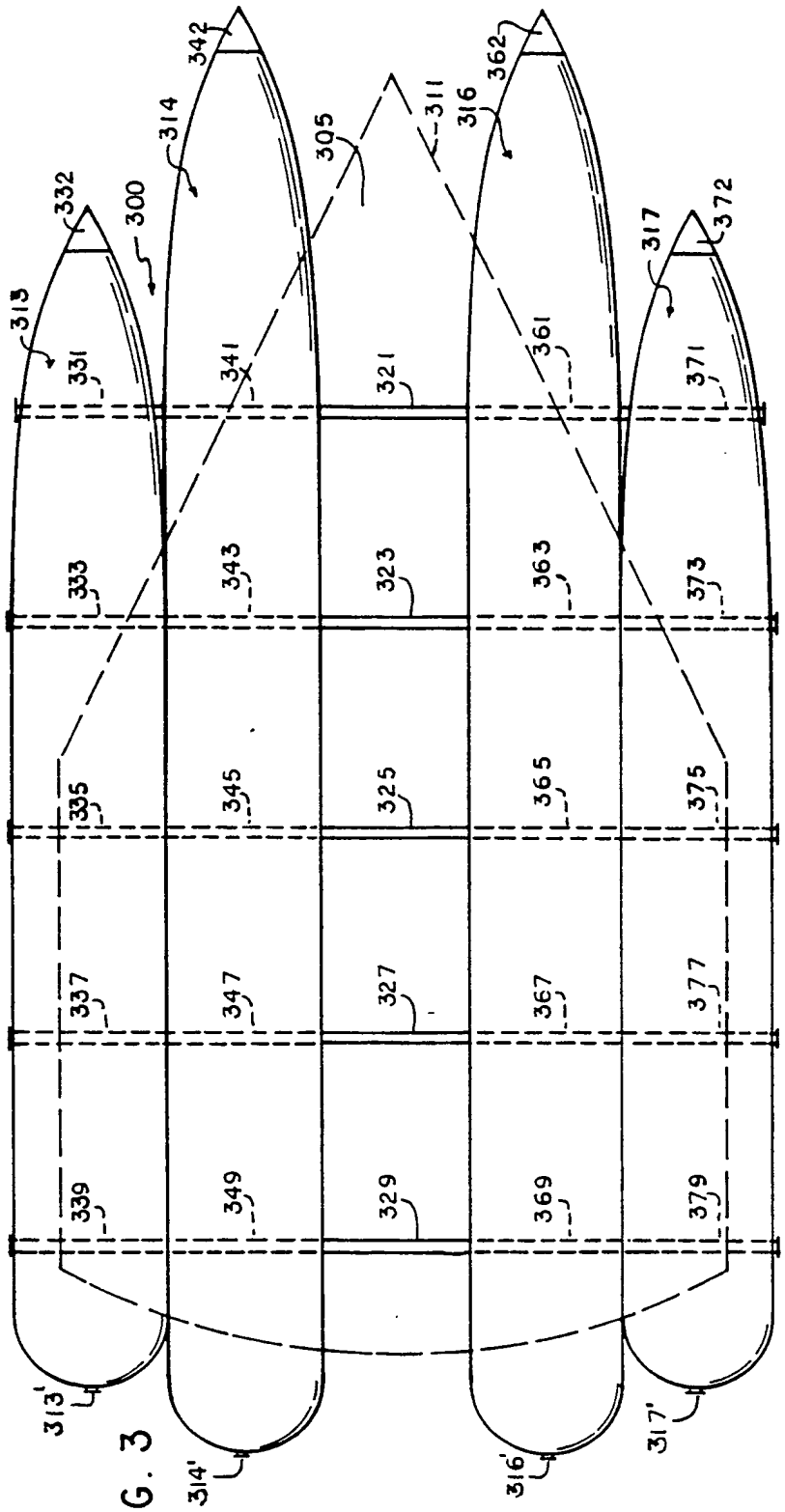


FIG. 3

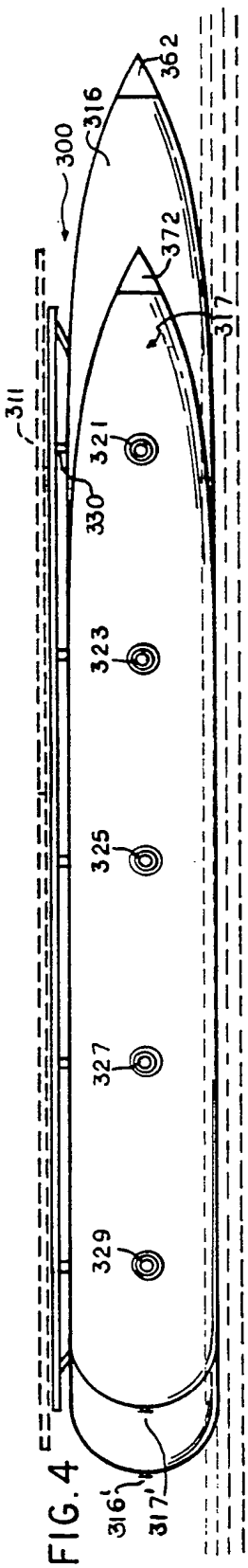


FIG. 4

FIG. 5

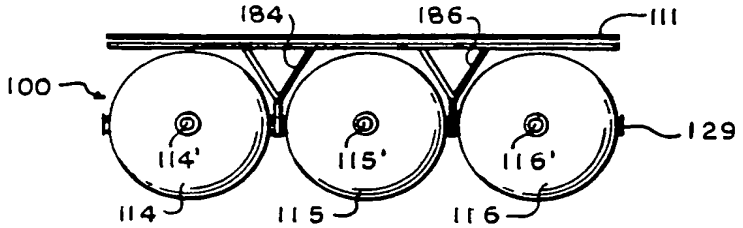


FIG. 6

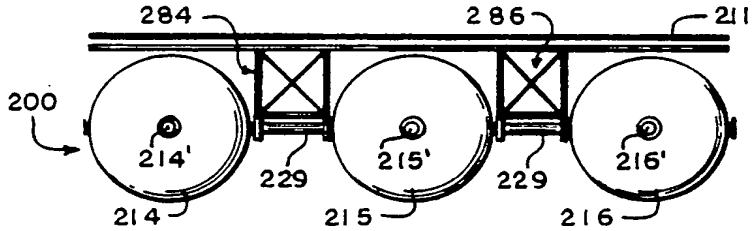


FIG. 7

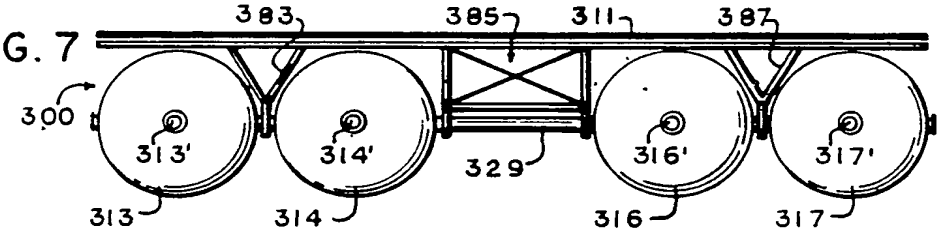


FIG.8

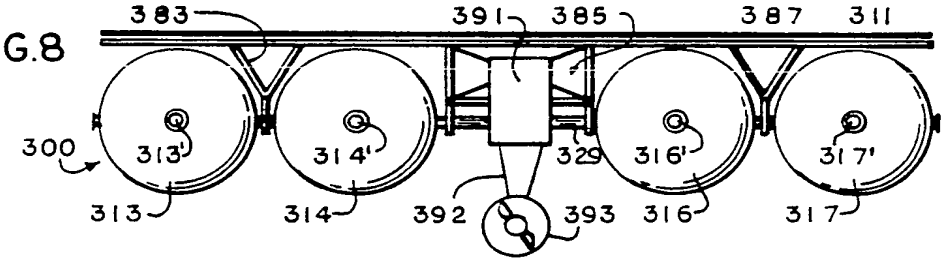


FIG. 9

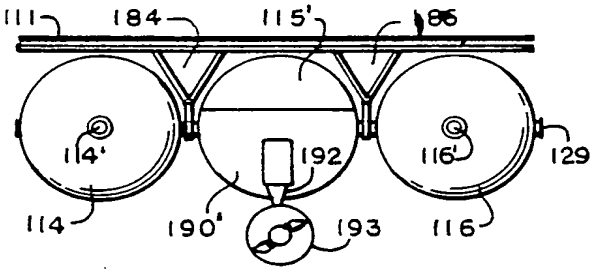


FIG. 10

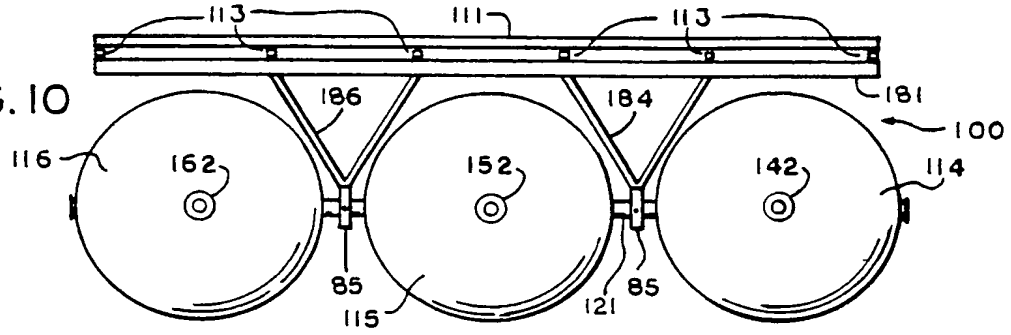


FIG. 11

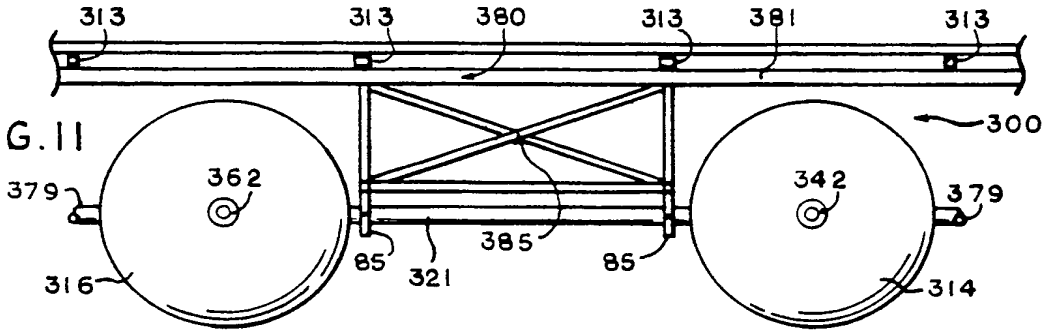


FIG. 12

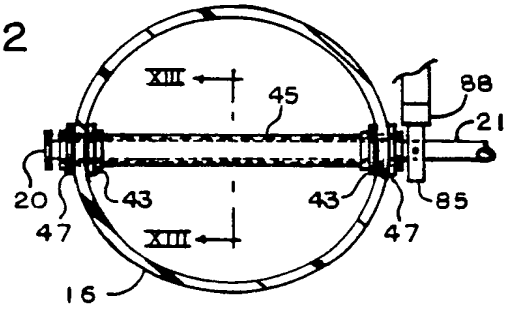


FIG. 13

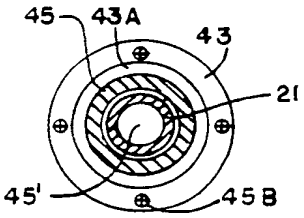


FIG. 15

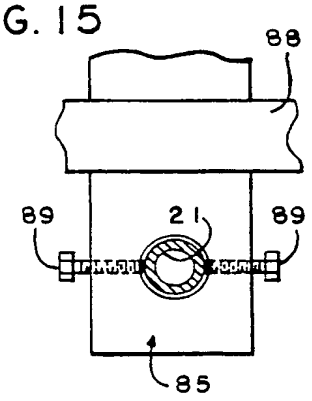


FIG. 15A

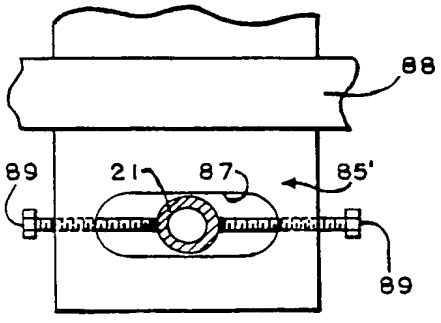
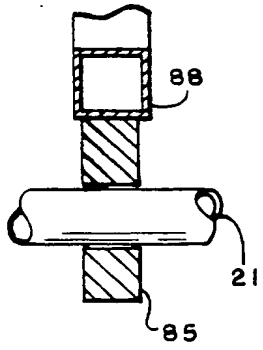


FIG. 14



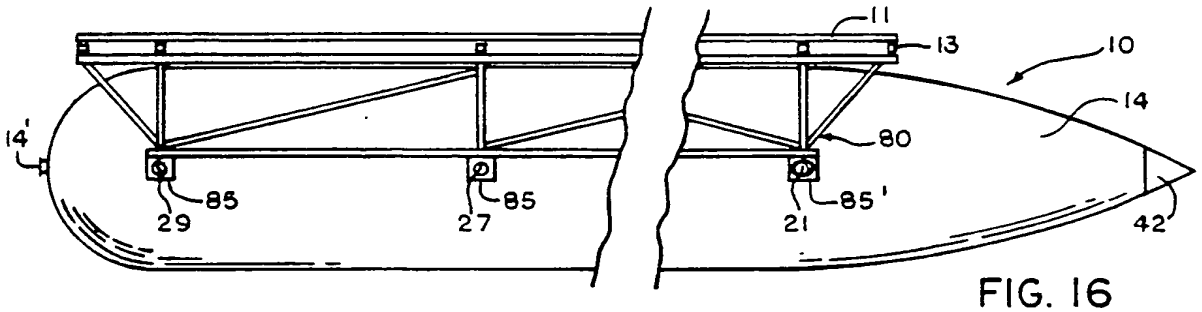


FIG. 16

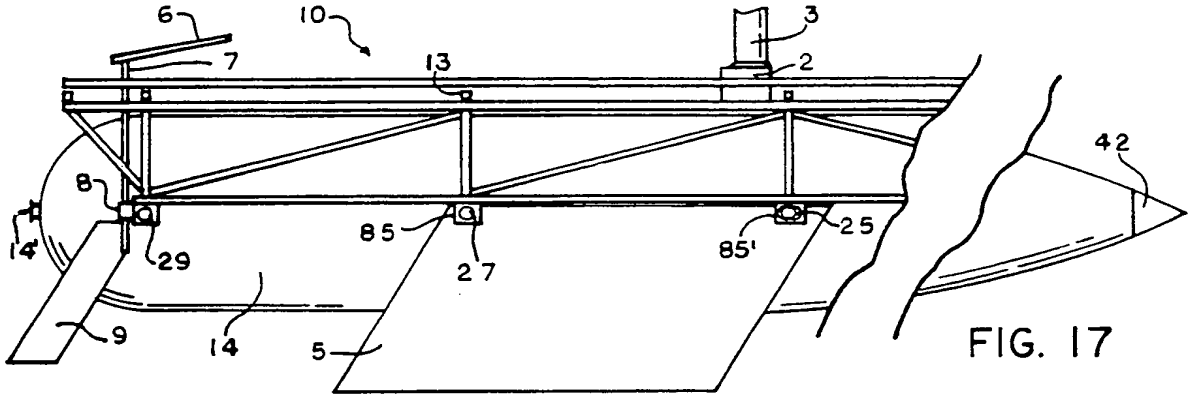


FIG. 17

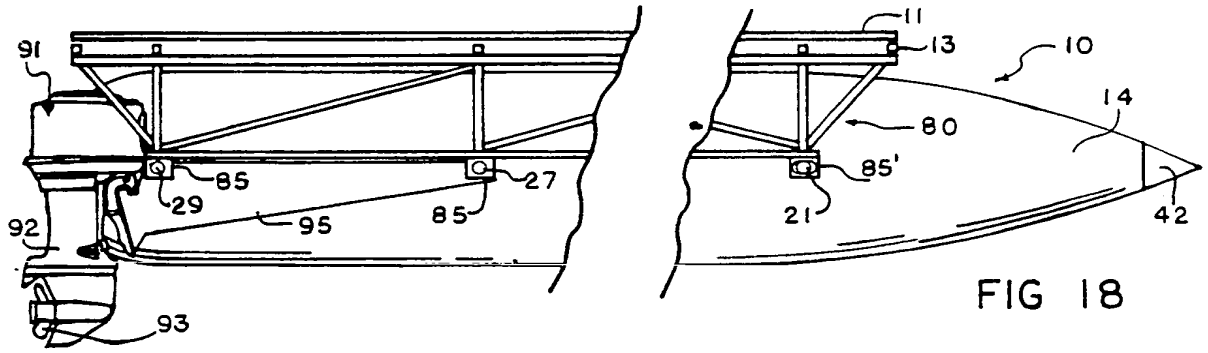


FIG 18

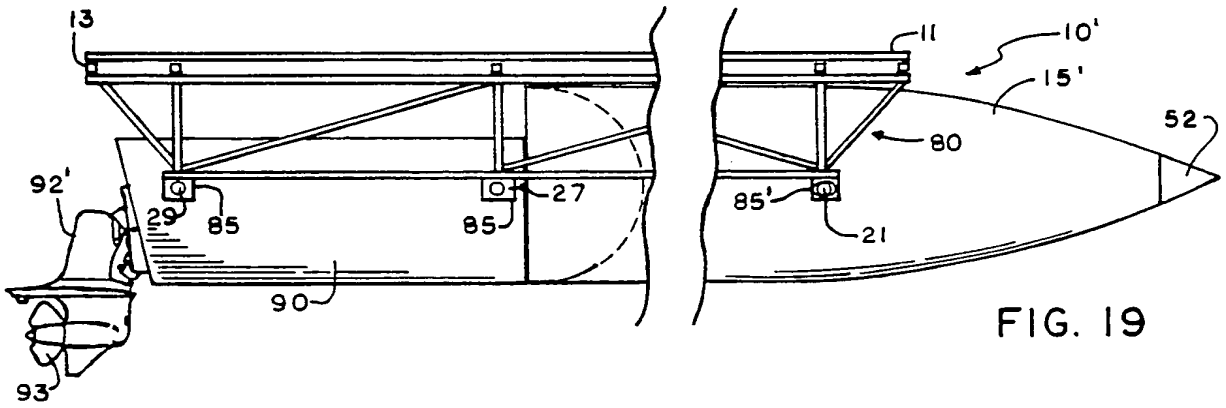


FIG. 19

FIG. 20

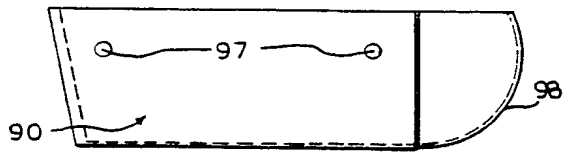


FIG. 21

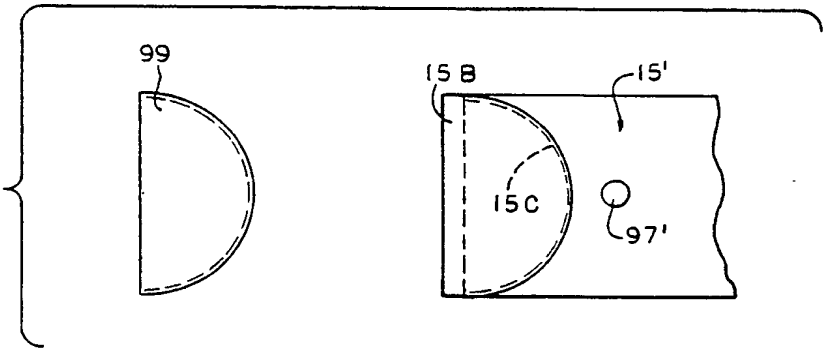


FIG. 22

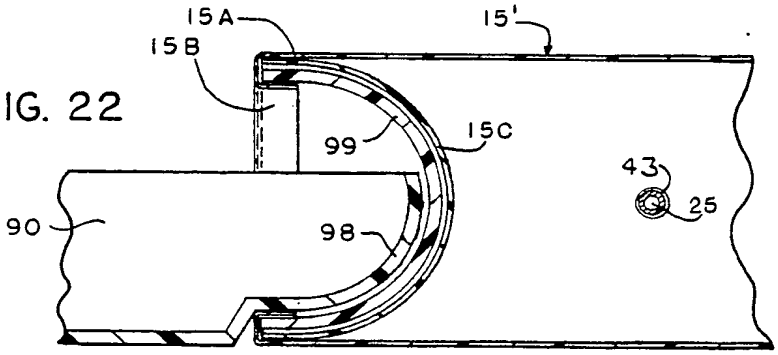


FIG. 23

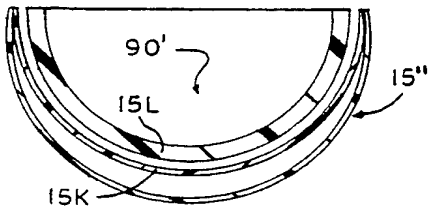
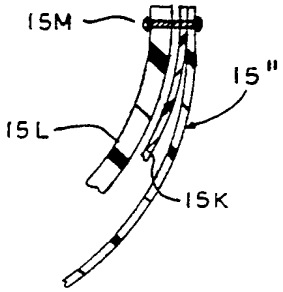


FIG. 24



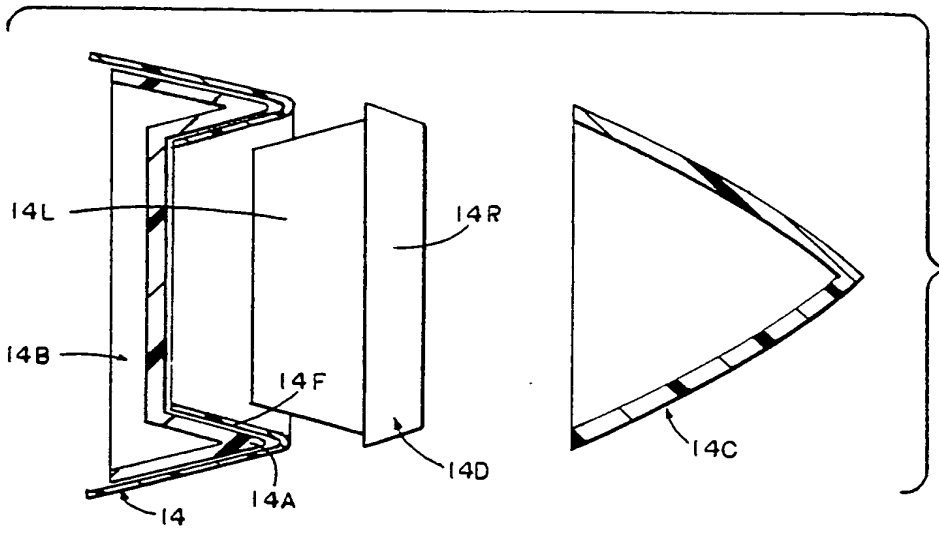


FIG. 27

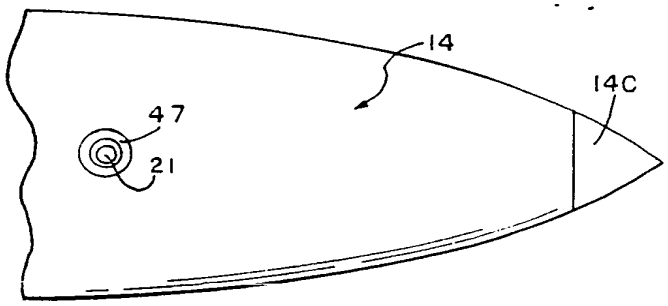


FIG. 26

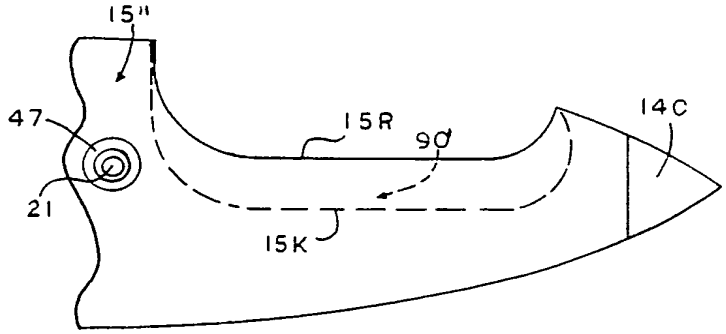


FIG. 25

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 86/01144

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 63 B 7/08; B 63 B 1/10

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	B 63 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	GB, A, 862278 (R.F.D. COMPANY LIMITED) 8 March 1961, see page 1, lines 23-35, 50-74; page 2, lines 1-12,35-47,54-61, 74-94; figures 1,2	1,2,3,7,9, 21,23,24
X	FR, A, 2453775 (P. TIJOUX) 7 November 1980, see page 4, lines 2-8; figures 3,5,6	1
A	DE, A, 2907518 (K. ENZMANN) 4 September 1980, see page 1, lines 11-15; figures 1,3	1
A	US, A, 3930274 (H. SYFRITT) 6 January 1976, see abstract; figures 2,3	4
A	GB, A, 2034253 (N.K. SHERWOOD) 4 June 1980, see page 1, lines 83-100; figure 1	4

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
17th September 1986	20 OCT 1986
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. VAN MOL

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/US 86/01144 (SA 13486)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 25/09/86

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 862278		None	
FR-A- 2453775	07/11/80	None	
DE-A- 2907518	04/09/80	US-A- 4406239	27/09/83
US-A- 3930274	06/01/76	US-A- 3846858	12/11/74
GB-A- 2034253	04/06/80	DE-A- 2945555	22/05/80
		AU-A- 5250179	19/06/80
		AU-B- 528269	21/04/83

For more details about this annex :
see Official Journal of the European Patent Office, No. 12/82